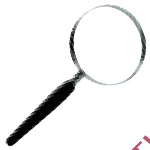
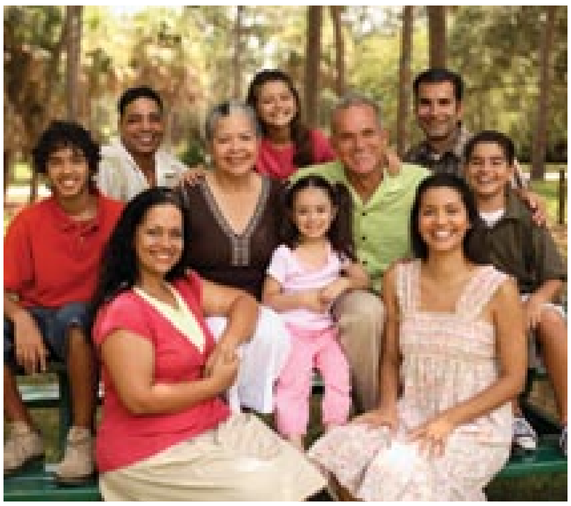
59 Gene Combo



INVESTIGATION

Although offspring receive all of their genes from their parents, the opportunity for variation is enormous. Think about your own family. If you have siblings, do they look like you? How closely do you and your siblings resemble your parents or your grandparents? An Austrian monk named Gregor Mendel studied the genetics of pea plants in the 1860s. Based on the results of his experiments with seed color and other pea traits, Mendel proposed a model for how organisms inherit traits from their parents.



You have explored a few hypotheses to explain the critter-breeding data. In this activity, you will investigate a hypothesis that is very similar to Mendel's hypothesis. Tossing coins is one way to model how genes are passed from parent to offspring. All of Skye and Poppy's offspring, including two named Ocean and Lucy, have blue tails. Why do some of Ocean and Lucy's offspring have orange tails? Find out by modeling the tail colors of the Generation Three offspring.

The Coin-Tossing Model

a. The outcome of a coin toss (heads or tails) represents the one version of a tail-color gene that is contained in the sex cell (sperm or egg) contributed by a parent critter. Heads represents the blue version and tails represents the orange version.

b. A future offspring critter receives a version of the tail-color gene from each of its two parents when fertilization occurs.

c. Each side of the coin represents one of the two versions of the tail-color gene carried by each Generation Two critter, such as Ocean and Lucy.

d. Blue tail color is **dominant** to orange tail color. This means that if a critter has at least one copy of the blue version of the gene, its tail is blue. A critter has an orange t ail only if it has no blue versions of the tail-color gene.

CHALLENGE

How can tossing coins help you understand how organisms inherit genes from their parents?

MATERIALS

For each pair of students

2 **pennies**

1 **Student Sheet 59.1, "Gene Combo Results"**

PROCEDURE

1. In your group of four students, divide into two pairs. Each pair should complete Steps 2–5.
2. Decide who will toss a penny to represent Ocean; the other person will toss a penny to represent Lucy. The outcome of each toss determines the tail-color gene each parent passes on to each critter pup.
3. Each person in your pair will toss a penny. For each toss, each partner should:
   - Hold a penny in cupped hands.
   - Shake it to the count of ten.
   - Allow it to drop from a height of about 20–40 cm (8–16 inches) onto the desk. Leave the pennies on the desk until you have completed Step 4.
4. Work with your partner to fill in the first row of Student Sheet 59.1, "Gene Combo Results," as shown below. Use these symbols to keep track of the genes:

   T = blue tail gene

   t = orange tail gene

   (You could use any letter you like, but **T** and **t** can remind you of "tail color." To make your gene symbols easy to tell apart we suggest you always underline the uppercase letter of the pair.)

For example, if Ocean's coin toss results in heads (**T**), and Lucy's coin toss results in tails (**t**), your first entry will be:

Gene Combo Results

Offspring	Ocean's Contribution (T or t?)	Lucy's Contribution (T or t?)	Offspring's Genes (TT, Tt, tT, or tt?)	Offspring's Tail Color (blue or orange?)
1	**T**	**t**	**Tt**	blue

Remember:
TT = *blue tail*
Tt, **tT** = *blue tail*
tt = *orange tail*

5. Repeat steps 2–4 until you have filled in every row of the table.
6. Get together with the other pair in your group to prepare a simple table summarizing your results. Include the total number of times you got each gene combo (**TT**, **Tt**, **tT**, or **tt**) and the number of times you got each tail color (blue or orange).
7. Report the summary of your results to your teacher.
8. Add another row to your table to record the class data.

ANALYSIS

1. What is the ratio of blue-tailed to orange-tailed critter pups? Use the class data to answer this question:

    a. Divide the number of blue-tailed offspring by the number of orange-tailed offspring.

    $$\textit{ratio of tail colors} = \frac{\textit{number of blue-tailed offspring}}{\textit{number of orange-tailed offspring}}$$

    b. Round this value to the nearest whole number. Then express it as a ratio by writing it like this:

    ______ : 1
    (whole number)

    c. Express this ratio as a pair of fractions, so that you can use them to complete the following sentence:

    "About ______ of the offspring have blue tails, and about ______ of the offspring have orange tails."

    d. Explain why the class obtained such a large ratio. For example, why isn't the ratio of blue to orange tails 1:1, that is, ½ blue and ½ orange?

2. You and your partner are about to toss two coins 100 times. Predict about how many times the outcome would be:
   - **a.** heads–heads
   - **b.** heads–tails
   - **c.** tails–heads
   - **d.** tails–tails

3. How sure are you that you will get exactly the results you predicted for Question 3? Explain your answer.

4. Look back at Activity 58, "Creature Features." Do the results of the coin-tossing model match the Generation Three critter data? Explain.

5. What are the advantages and disadvantages of using coin tosses in a model for how genes are passed from parents to offspring? Explain.

6. Review the rules of genetics that the class developed in the last activity. Which ones make this model work?

7. Write your own definition of the phrase *dominant trait* as it is used in genetics. **Hint:** Does it mean that every time any pair of critters mates, most of the offspring will have blue tails? Why or why not?

EXTENSION

For a larger sample size, view the data gathered by fellow students from other locations. Go to the *Issues and Life Science* page of the SEPUP website for instructions.